



Grilamid TR

**Clear Choice in
Transparent Polyamides**

Grilamid TR[®]
EMS



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Grilamid TR

■ Introduction

Grilamid TR is the trade name for EMS-GRIVORY's family of amorphous polyamides based on cycloaliphatic and aromatic blocks. Careful selection of the monomers results in stellar transparency threaded in the family's DNA.

Grilamid TR product line combines optical clarity with high-performance attributes:

- Brilliant transparency
- Excellent fatigue resistance
- Superior dynamic strength
- High chemical resistance
- Extraordinary environmental stress crack resistance (ESCR)
- Low specific gravity
- Minimal water absorption
- Long-term thermal stability
- Barrier resistance to O₂, N₂, and CO₂
- High impact strength at low temperatures
- Exceptional dimensional stability
- Outstanding resistance to weathering

Grilamid TR' robust properties succeed where other transparent polymers fail in achieving stringent requirements in optics, electronics, healthcare, safety, sanitary, household, sports, and automotive markets. Grilamid TR is a suitable fit in glass replacement applications. Reinforced Grilamid TR offers lightweight metal replacement options exhibiting high stiffness, high strength, low warpage, very low creep, high heat distortion temperatures, very low moisture absorption, and excellent surface appearance. Grilamid TR family's outstanding processability, versatility in production methods, vibrant colorization, and bold printability fosters creative design freedom.

Meet the Family:

- Grilamid TR 30 – The Scratch Resistant
- Grilamid TR 55 – The All Rounder
- Grilamid TR 90 – The Tough Guy
- Grilamid TR ICR – The ESCR Challenger
- Grilamid TR HT – The Hot Performer






■ The Clear Choice

Grilamid TR fits in between other amorphous thermoplastics balancing stiffness and heat distortion without compromising transparency.

Grilamid TR exhibits excellent resistance to UV, stress cracking, and chemicals compared to other transparent thermoplastic polymers.

Grilamid TR 30 resists stress cracking and yields high impact compared to acrylic polymers. Grilamid TR 55, Grilamid TR 30, and Grilamid TR HTs demonstrate higher heat deformation temperatures compared to acrylic polymers.

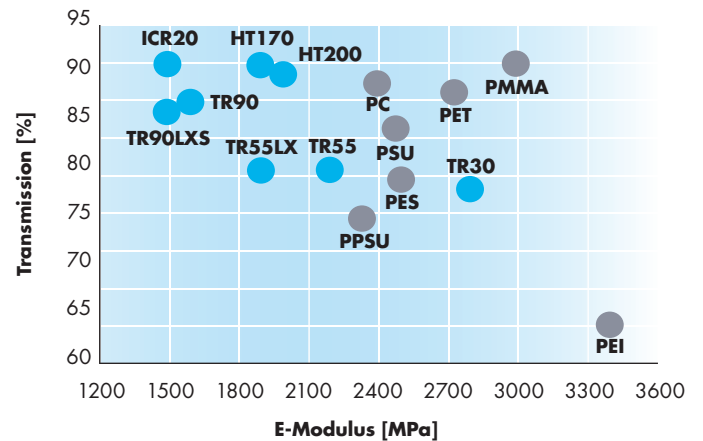
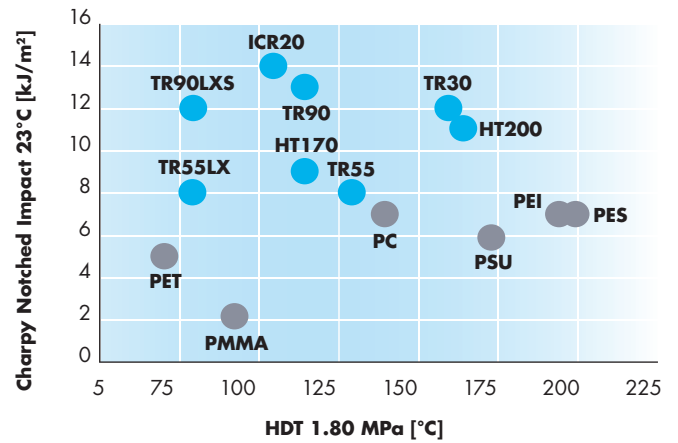
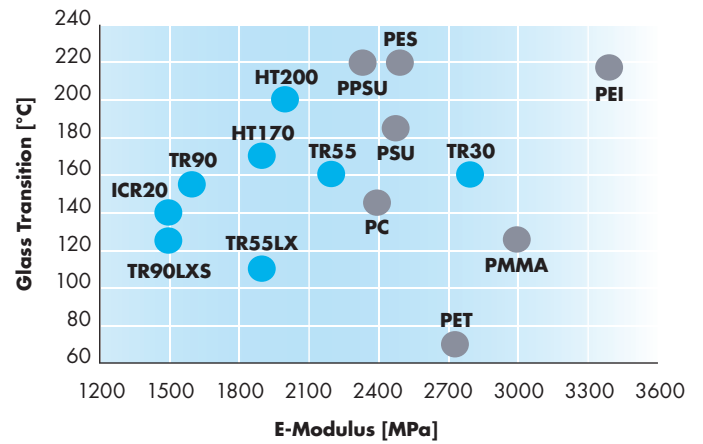
Crystal Clear
Transparency



Dynamic
Fatigue Resistance

Chemical & Stress
Crack Resistance

Grilamid TR®



Transmission measured on 3 mm thick plates at 560 nm

Property Comparison

Grilamid TR demonstrates equal to elevated performance when comparing key properties such as transparency, chemical resistance, and processability to

amorphous thermoplastics such as polycarbonate (PC), polysulfone (PSU), polyethersulfone (PES), and polyetherimide (PEI).

Properties	TR 30	TR 55	TR 90	ICR 20	HT 170	HT 200	PC	PSU	PES	PEI
Transparency	●●●	●●●	●●●	●●●	●●●	●●●	●●●	○	○	○
Bisphenol A (BPA) Free	●●●	●●●	●●●	●●●	●●●	●●●	○	○	●●	●●
Bisphenol S (BPS) Free	●●●	●●●	●●●	●●●	●●●	●●●	●●	○	○	●●
Chemical Resistance	●●	●●	●●	●●●	●●	●●	○	●●	●●	●
Density	●	●●●	●●●	●	●●●	●●●	○	○	○	○
Waterresistance	○	●●	●●	●	●●●	●●●	●●	●●	●●	-
Steam Resistance	○	●	●	●	●●	●●●	●●	●●	●●	●
Bonding with Liquid Silicone Rubber (LSR)	●●	●●	●●	●	●●	●●●*	●	○	○	○
Processing	●●	●●	●●	●●	●●	●●	●●	○	○	○

- Very Good
- Good
- Satisfactory
- Poor

* Corona treatment recommended for improved bonding.

Stress Crack Resistance

Environmental stress cracking (ESC) is a failure mode where a material fractures, either partially or completely, from chemical exposure under stress. Most amorphous polymers demonstrate chemical resistance but fail under applied stresses. ESC resistance testing, based on DIN 53449, subjects the material to bending stress under a 1-minute solvent immersion at 23°C.

Chemical attack observed in the form of cracks, crazing, or other surface degradation mechanism indicates incompatibility for crucial applications. Grilamid TR exhibits better resistance to alcohol, ketone and aromatic solvents compared to polycarbonate (PC) and polyethylene terephthalate glycol (PETG).

Material	Grilamid TR 55		Grilamid TR 90		Grilamid TR ICR 20		Grilamid TR HT 200		PC		PETG	
	1	3	1	3	1	3	1	3	1	3	1	3
90% Ethyl Alcohol	●●	○	●●	●●	●●●	●●●	●●●	●	●●	○	●●	○
90% Isopropyl Alcohol	●●	○	●●●	●●●	●●●	●●●	●●	●●	●●	○	●●	○
Acetone	●●●	●●	●●●	●●●	●●●	●●	●●●	●●	○	○	●●	○
Butanone	●●●	●●	●●●	●●	●●●	●●	●●●	●●	○	○	○	○
Toluene	●●●	●●	●●●	●●●	●●●	●●	●●●	●●●	○	○	○	○

- Resistant – no visible cracks, no change in surface appearance
- Limited Resistance – small cracks visible, surface dissolves,
- Not resistant – major cracks, very brittle



■ Sterilization Resistance

Sterilization is an important disinfectant process widely used in medical applications. It is gaining momentum in domestic sectors such as households, schools, restaurant, and stores. Sterilization methods require highly durable materials to withstand the destructive process.

Grilamid TR is resistant to damaging effects of rigorous sterilization methods such as ethylene oxide (EtO), gamma irradiation (40 kGy maximum), and hydrogen peroxide (54 minutes 50°C). Grilamid TR HT 200, designed specifically for steam sterilization, shows no deformation or clouding. Grilamid TR HT 170, designed for hot water steam resistance, is suitable for household applications.

Property	Grilamid TR 30	Grilamid TR 55	Grilamid TR HT 170	Grilamid TR 90	Grilamid TR HT 200
Ethylene Oxide (EtO)	☑	☑	☑	☑	☑
Gamma Irradiation, < 40 kGy	☑	☑	☑	☑	☑
Hydrogen Peroxide, 54 minutes 50°C	☑	☑	☑	☑	☑
Steam Sterilization Cycles, 18 minutes at 134°C	0	0	0	0	500
Cooking Steam Cycles, 75 minutes at 100°C	–	160	> 1000	–	–

☑ Resistant ☒ Not Resistant – Not Applicable

■ Agency and Regulatory Approvals

Grilamid TR products hold approvals in medical, safety, food contact, water contact, and automotive markets. The following table summarizes approvals within

the different markets. Approvals are limited to specific product color, product modification, and agency specification.

Agency	Grilamid TR 30	Grilamid TR 55	Grilamid TR HT 170	Grilamid TR 90	Grilamid TR ICR 12	Grilamid TR HT 200	Grilamid TRV
EU Food Contact	☑	☑	☑	☑	☑	☑	–
FDA Food Contact	☑	☑	☑	☑	☑	ongoing*	–
USP Class VI	–	☑	–	☑	☑	☑	–
ISO 10993	☑	☑	–	☑	☑	☑	–
NSF 61 Water Contact	☑	☑	–	☑	–	–	☑
WRAS Water Contact	☑	☑	–	☑	–	–	–
UL	☑	☑	–	☑	☑	–	☑
Stellantis	☑	–	–	☑	–	–	–
Ford	–	☑	–	–	–	–	–
GM	☑	–	–	☑	–	–	–

☑ Compliant – Not Available * Estimated completion is 2024

Grilamid TR

■ Product Features

■ Grilamid TR HT 200

Grilamid TR HT 200 is the steam sterilizable member of the Grilamid TR family. It is an ideal solution for applications demanding excellent performance under high heat environments while exhibiting other desirable properties:

- 200°C glass transition temperature
- Steam sterilizable at 134°C
- Excellent transparency after 500 steam cycles
- High chemical and stress crack resistance
- High heat distortion performance
- Permanent transparency
- Low moisture absorption
- Excellent scratch resistance
- Adhesion to LSR

Grilamid TR HT 200 is suitable for various application fields such as medical, domestic, industrial, sanitary, automotive, and electronics. Some applications include suction pump jars, anesthesia masks, forced respiration valves, sterilization machines, kitchen appliance parts, and polysulfone replacement.





■ Grilamid TR HT 170

Grilamid TR HT 170 is a modified Grilamid TR 55 with specialized design for use in hot water steam applications. Key properties of Grilamid TR HT 170 include:

- 170°C glass transition temperature
- Steam resistant up to 100°C
- High clarity after over 1000 steam cycles
- Good stress crack resistance
- Low moisture absorption
- Low weight and density
- Good impact performance
- Good processability

Grilamid TR HT 170 presents solutions in domestic, household, and medical applications such as baby

bottles, cooker lids, and steam cooker housings. Grilamid TR HT 170 is also an all-rounder with properties desirable in all market segments.

Grilamid TR

■ Grilamid TR ICR

Grilamid TR ICR 12 LS and Grilamid TR ICR 20 are particularly stress-crack resistant members of the Grilamid TR family. Both are microcrystalline modifications of Grilamid TR 90 bringing together semi-crystalline and amorphous properties while maintaining high transparency. Grilamid TR ICR 12 LS offers improved stress crack resistance against nonpolar solvents and alcohols in addition to high UV resistance. Grilamid TR ICR 20 offers the best chemical and stress crack resistance, especially against alcohols, of the Grilamid TR family. Other key features of Grilamid TR ICR products include:

- High transparency and excellent surface quality
- Excellent flexural and fatigue strength
- High impact at subzero temperatures
- Ductile break behavior
- Excellent chemical resistance

Grilamid TR ICR 12 LS is suited for outdoor applications and filter bowls in sanitary, electrical, safety, domestic, engineering, and agricultural markets. Grilamid TR ICR 20 is suited for alcohol-resistant applications in optical and high flexibility applications in medical, sports, safety, and domestic markets.





■ Grilamid TR 90

Grilamid TR 90 is the tough guy of the Grilamid TR® family. It takes the lead over other amorphous thermoplastics in performance and appearance. It meets rigorous requirements in demanding applications. Grilamid TR 90 elevates the standard for transparency while presenting a scroll of viable properties:

- Crystal clear, permanent transparency, very good impact strength
- Excellent chemical resistance
- Superb stress-crack resistance
- Exceptional toughness and stiffness
- Superior fatigue resistance
- Extraordinary strength in ultra-cold temperatures
- Medical, safety, food, and water approvals
- Unlimited color ability

Grilamid TR 90 modifications:

- LS – Easy processing and demoulding
- LXS – Improved alcohol resistance and easy processing, improved flow
- NZ – Improved impact performance
- NZZ – Extreme impact performance
- TL – Improved stiffness and stress crack resistance
- UV – Improved UV resistance

Grilamid TR

■ Grilamid TR 55

Grilamid TR 55 is the all-rounder member of the Grilamid TR family. It exhibits a balanced property profile fitting into many different applications across markets including medical, domestic, industrial, sanitary, automotive, and electronics. Grilamid TR 55 presents desirable attributes including:

- Outstanding transparency
- High toughness and stiffness
- Excellent stress crack resistance
- Good chemical resistance
- Medical, safety, food, and water approvals
- Unlimited color ability

Grilamid TR 55 modifications:

- LX – Improved alcohol resistance
- UV – UV resistance

Grilamid TR 55 is suitable for electrical connectors, sensor housings, fuel separators, lubricant containers, flow meters, foodstuff containers, and baby bottles.





■ Grilamid TR 30

Grilamid TR 30 is the member with the best scratch resistance of the Grilamid TR family. The Grilamid TR 30 structure is resulting in very high stiffness and very high surface hardness. Key features of Grilamid TR 30 coupled with excellent transparency include:

- Good impact strength
- Good chemical resistance especially against oil, grease, and fuels
- Good stress crack resistance
- Good scratch resistance
- High surface hardness

Grilamid® TR 30 modifications:

- TR 30 LS – Easy processing and demoulding
- TR XE 4139 – Improved heat resistance, UV resistance, and easy processing. Suitable for automotive interior components. Available in piano black color.

Grilamid TR 30 is the ideal solution for fuel filters, fuel separators, electrical covers, connectors, flow meters, and PMMA alternative for displays.

■ Grilamid BTR

EMS-GRIVORY GreenLine encompasses bio-based polyamides manufactured from renewable raw materials and contributes to the reduction of emission. The castor oil plant (*ricinus communis*) is the renewable resource for GreenLine products. The product's bio-content is the percent of total carbon determined in accordance with ASTM D 6866-12. Total emissions from GreenLine manufacturing process reduces environmental impact up to 75% compared to crude-oil based polyamides. GreenLine products retain the excellent properties of its respective family. Despite the use of renewable raw materials, GreenLine products are not biodegradable. Their durability is comparable to crude-oil based polyamides.

Grilamid BTR is the GreenLine representative of the Grilamid TR family with up to 54% bio-content. Key features include:

- High transparency
- High flexural fatigue strength and impact resistance
- Very good chemical resistance
- High gloss and excellent surface quality
- Improved melt flow and demolding properties





■ Grilamid TR Reinforced

The Grilamid TR portfolio offers a series of amorphous glass fiber reinforced products. Products exhibit excellent dimensional stability, low warpage, low flashing, minimal sinking, high heat distortion temperature, high stiffness and strength, high chemical resistance, surface quality, low moisture absorption, and excellent creep resistance.

Reinforced Grilamid TR is a top choice for high precision structural parts as well as an ideal solution to warpage and distortion occurrences in thin-walled parts.

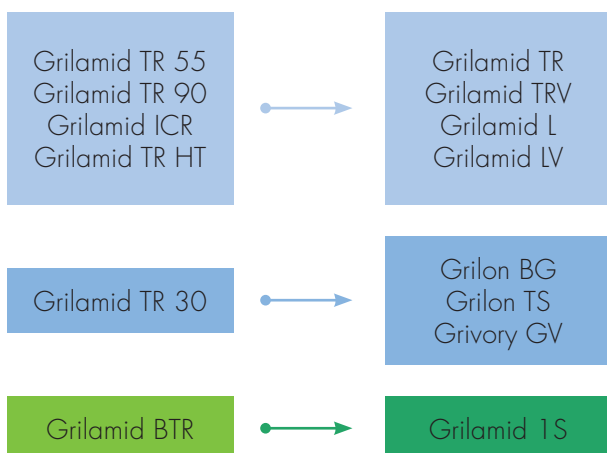
■ Special Feature: Grilamid TR in Diffused Lighting

Special modifications of Grilamid TR 30 and Grilamid TR 90 tune the opacity and light diffusion properties into a softened glow desirable in ambient lighting applications.

Grilamid TR 30 based grades offer excellent scratch resistance, chemical resistance, and high stiffness. Grilamid TR 90 based grades maintain excellent UV resistance, low density, and excellent stress-crack resistance.

■ Special Feature: Grilamid TR in Multi-Material Designs

Grilamid TR products' versatility continues to multi-material components. The combination of complimentary EMS-GRIVORY grades presents a solution or enhancement in functional and structural applications. Best polymer-to-polymer adhesion combinations within the EMS-GRIVORY portfolio:



Grilamid TRV

- 40% standard glass fibers

Grilamid TRVX

- 50% specialty glass fibers
- Improved transverse dimensional stability

Transparent and ambient lighting Grilamid TR grades suitable in glass replacement applications as well as luminary applications in household, sanitary, food processing, flooring, aerospace, industrial, commercial, safety, and automotive markets.

Material Properties Grilamid TR Assortment

Properties	Standard	Unit	TR 30 dry/cond.	TR 55 dry/cond.	TR 90 dry/cond.	BTR 600 LS dry/cond.	ICR 12 LS dry/cond.	ICR 20 dry/cond.	TR HT 170 dry/cond.	TR HT 200 dry/cond.
Tensile Modulus	ISO 527	MPa	-/2800	2300/ 2200	1600/ 1600	1700/ 1700	1500/ 1500	1500/ 1500	-/1900	2000/ 2000
Tensile Yield Stress	ISO 527	MPa	-/90	80/75	60/60	65/65	60/60	60/60	-/70	80/75
Tensile Yield Strain	ISO 527	MPa	-/6	7/9	7/6	7/7	7/7	7/6	7/7	8/8
Charpy Notched Impact +23°C	ISO 179	kJ/m ²	-/12	8/8	13/13	10/10	15/15	14/14	-/9	7/11
Ball Indentation Hardness	ISO 2039-1	MPa	-/160	130/ 120	95/90	120/ 110	100/ 100	100/ 95	-/-	130/ 125
Glass Transition (10°C/min)	ISO 11357	°C	160/-	160/-	155/-	118/-	145/-	140/-	170/-	200/-
Heat Deflection 1.80 MPa	ISO 75	°C	125/-	130/-	115/-	90/-	105/-	105/-	130/-	165/-
Density	ISO 1183	g/cm ³	1.15/-	1.06/-	1.00/-	1.02/-	1.02/-	1.02/-	1.04/-	1.04/-
Water Absorption, 23°C	ISO 62	%	9.0/-	3.5/-	3.0/-	3.8/-	3.0/-	3.5/-	3.8/-	4.5/-
Moisture Absorption, 23°C/50%	ISO 62	%	3.5/-	1.5/-	1.5/-	1.8/-	1.5/-	1.5/-	1.5/-	1.7/-
Mold Shrinkage (Longitudinal)	ISO 294	%	0.65/-	0.60/-	0.65/-	0.45/-	0.65/-	0.65/-	0.60/-	0.60/-
Mold Shrinkage (Transverse)	ISO 294	%	0.70/-	0.70/-	0.75/-	0.50/-	0.70/-	0.75/-	0.70/-	0.90/-
Tool Temperature	-	°C	80 to 120	80 to 110	60 to 80	70 to 90	60 to 80	60 to 80	80 to 120	100 to 140
Processing Melt Range	-	°C	290 to 310	280 to 300	260 to 280	260 to 280	280 to 300	280 to 300	290 to 310	300 to 320



■ Material Properties Grilamid TR Reinforced Grades

Properties	Standard	Unit	TRV-4X9	TRVX-50X9
Glass Content	ISO 3451	%	40	50
E-Modulus	ISO 527	MPa	10000/ 9000	13000/ 12500
Tensile Stress at break	ISO 527	MPa	130/130	170/160
Tensile Break Strain	ISO 527	MPa	3.5/2.0	2.0/2.0
Charpy Impact +23°C	ISO 179	kJ/m ²	65/45	65/65
Charpy Notched Impact +23°C	ISO 179 ISO11357	kJ/m ²	14/14	16/16
Ball Indentation Hardness	ISO 2039-1	MPa	165/ 160	190/190
Glass Transition (10°C/min)	ISO 11357	°C	155/-	125/-
Heat Deflection 1.80 MPa	ISO 75	°C	135/-	115/-
Density	ISO 1183	g/cm ³	1.32/-	1.50/-
Water Absorption, 23°C	ISO 62	%	1.5/-	1.3/-
Moisture Absorption, 23°C/50%	ISO 62	%	0.8/-	0.6/-
Shrinkage (Longitudinal)	ISO 294	%	0.05/-	0.05/-
Shrinkage (Transverse)	ISO 294	%	0.40/-	0.15/-
Tool Temperature	-	°C	80 to 100	60 to 100
Processing Melt Range	-	°C	280 to 300	280 to 300



■ Masterbatches

Grilamid TR with masterbatches (MB) to enhance properties without adverse effects on mechanical proper-

ties. Table below lists the master batch for the associated application and base resin.

Grilamid TR Product	Application	Grilamid TR MB	Concentration [% w/w]
All Grilamid TR except TR 30 and TR 30 based grades	UV Stability	MB XE 3680	3 to 5
TR 30, TR 30 based grades	Natural Color Correction Agent	MB TR 30 Blue 4548	1 to 4
TR 30, TR 30 based grades	Demoulding and Flow Behavior	MB XE 4140	2 to 5
TR 30, TR 30 based grades	Heat and UV Stability	MB XE 4141	2 to 4
TR 55, TR 55 based grades, TR HT 170	Demoulding and Flow Behavior	MB 6960 LS	3 to 5
TR 55, TR 55 based grades, TR HT 170	Natural Color Correction Agent	MB TR 55 Blue 4545	2 to 5
TR 55, TR 55 based grades, TR HT 170	Natural Color Correction Agent*	MB TR 55 Violet 4516	1 to 2
TR 90, TR 90 based grades	Demoulding and Flow Behavior	MB 5032 LS	3 to 5
TR 90, TR 90 based grades	Natural Color Correction Agent	MB TR 90 Blue 4545	2 to 5
TR 90, TR 90 based grades	Natural Color Correction Agent*	MB TR 90 violet 4516	1 to 2
TR HT 200	Natural Color Correction Agent*	MB TR 60 Violet 4518	2 to 5
TR HT 200	Demoulding and Flow Behavior	MB XE 4034 LS	3 to 5

*FDA and EU Food Contact Compliant





■ **EMS-GRIVORY** **Service and Support**

EMS-GRIVORY is a specialist in polyamide synthesis and the processing of polyamide materials. Our services focus on the success of customer applications with our specialty products and range from manufacturing and material supply to full technical support.

Quality System Certification
IATF 16949:2016
All manufacturing sites

Laboratory Accreditation
ISO/IEC 17025:2017
Sumter South Carolina Site

Design Concept
Design Proposals (Variants)
Part Cost Calculations

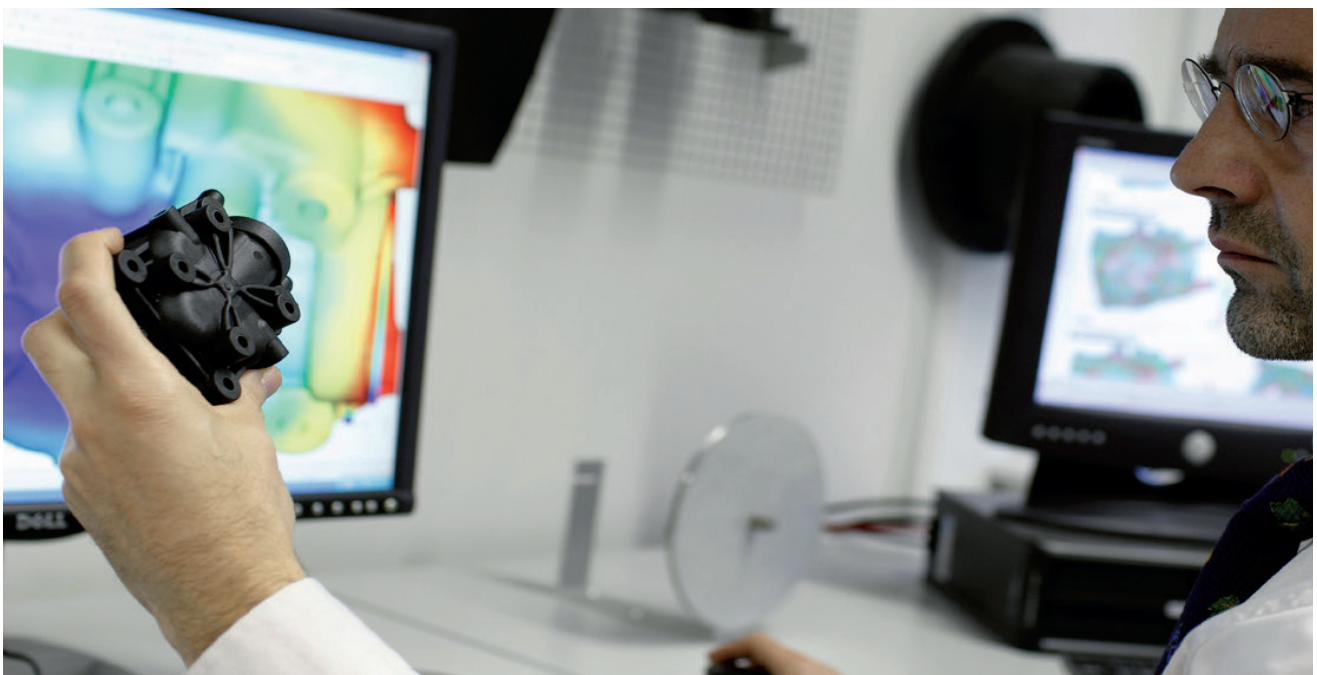
Material Selection
Comparative evaluation

Design Evaluation
Design recommendations
Moldflow and FEA

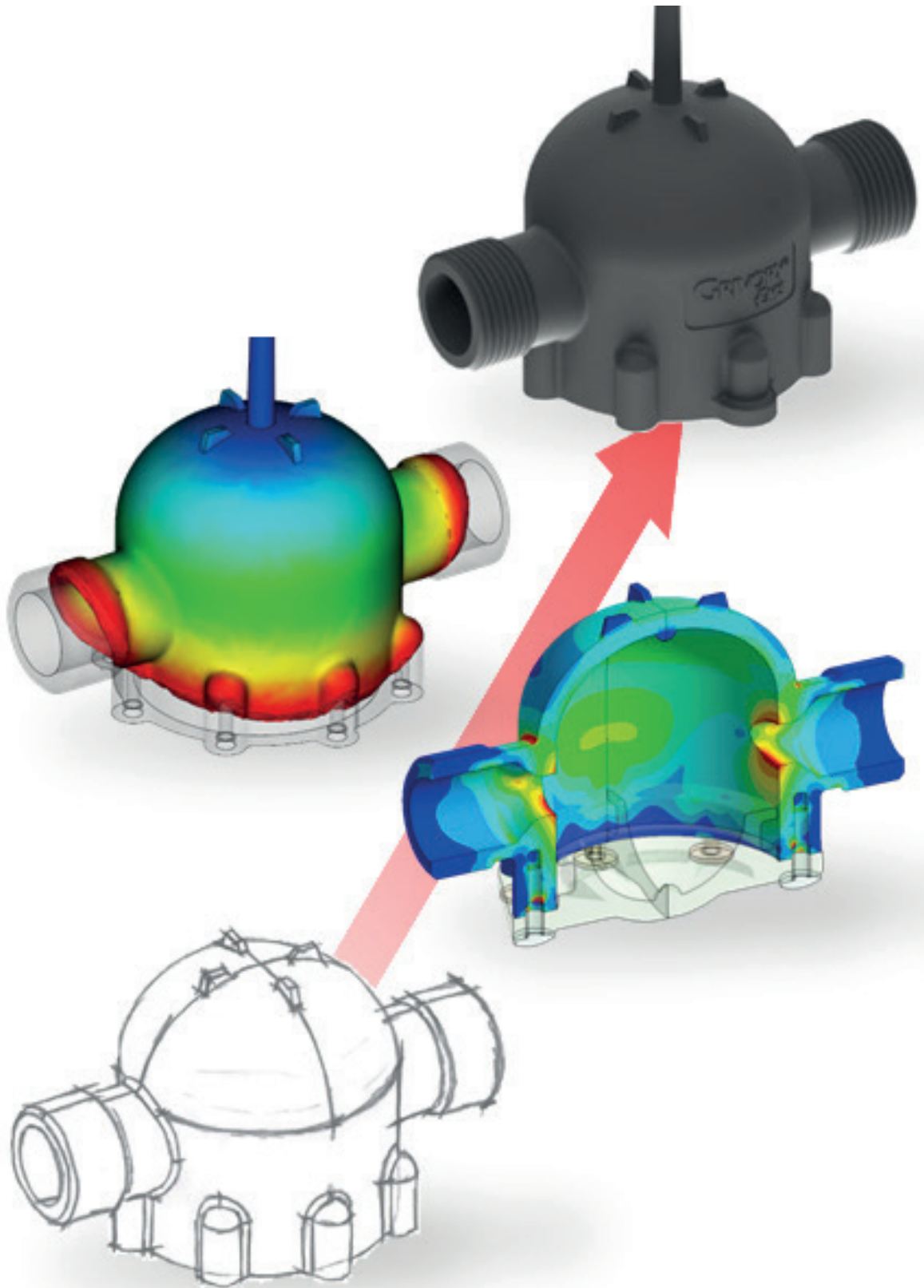
Prototypes
Prototype production
Die cast tool modification

Application Related Tests
Test method development
Characterization and Analysis

Sampling and start of production
Processing and tool optimization



Grilamid TR





EMS-GRIVORY worldwide

www.emsgrivory.com

EMS-GRIVORY – The leading manufacturer of high-performance polyamides

EMS-GRIVORY is the leading manufacturer of high-performance polyamides and the supplier with the widest range of polyamide materials. Our products are well-known throughout the world under the trademarks Grilamid, Grivory and Grilon.

We offer our customers a comprehensive package of high-capacity and high-quality products along with segment-specific advisory competence in distribution and application development. We maintain our market leadership through continual product and application development in all segments.

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